



# **MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR  
THIRD YEAR FIRST SEMESTER**

**SCHOOL OF PURE APPLIED AND HEALTH  
SCIENCES  
BACHELOR OF SCIENCE IN CHEMISTRY**

**COURSE CODE: CHE 3120**

**COURSE TITLE: SURFACE AND COLLOIDAL  
CHEMISTRY**

**DATE: 8<sup>TH</sup> APRIL, 2022**

**TIME: 0830-1030**

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**INSTRUCTIONS TO CANDIDATES**

1. Answer Question **ONE** and any other **TWO** questions.
2. All Examination Rules Apply.

### QUESTION ONE (30MKS)

- a) Define the following terms as used in surface chemistry.
- Adsorption
  - Adsorbate
  - Adsorbent **(3mks)**
- b) Calculate the height of liquid A that must have risen in a capillary tube of radius 0.2 mm. The surface tension of the the liquid is  $0.023 \text{ NM}^{-1}$  at  $20 \text{ }^\circ\text{C}$  with density of  $800 \text{ KgM}^{-3}$ . **(3mks)**
- c) Describe the process of capillary zone electrophoresis **(4mks)**
- d) The surface tension of  $\text{CHCl}_3$  at  $20 \text{ }^\circ\text{C}$  is  $0.03 \text{ NM}^{-1}$ . The densities of water and  $\text{CHCl}_3$  are  $1000 \text{ KgM}^{-3}$  and  $1600 \text{ KgM}^{-3}$  respectively. If the rise of  $\text{CHCl}_3$  and water in a capillary tube of certain diameter is 2 cm and 10 cm respectively;
- Calculate the surface tension of water **(4mks)**
  - Calculate the radius of the tube **(2mks)**
- e) Define the following terms:
- A sol
  - An aerosol
  - An emulsion **(3mks)**
- f) Explain two characteristics of polymers. **(4mks)**
- g) Describe the methods used to form colloidal dispersions in extrinsic colloids **(4mks)**
- h) State the two factors influencing the properties of a polymer. **(2mks)**
- i) Define the term polymer morphology. **(1mk)**

### QUESTION TWO (20MKS)

- a) Derive the Langmuir adsorption isotherm for adsorption with dissociation. **(4mks)**
- b) A surface quarter-covered by a gas when the pressure is two atmosphere. The simple Langmuir isotherm for adsorption without dissociation applies.
- What is  $K/\text{atm}$
  - What pressure gives 75% coverage **(4mks)**
- c) Explain what is meant by:
- Polymer rheology
  - Shear
  - Vitrification
  - Colloids. **(4mks)**

- d) Briefly explain the four phenomena that affect electro-migration  
(8mks)

**QUESTION THREE (20MKS)**

- a) The pressure of Nitrogen required for adsorption of  $1.0 \text{ cm}^3\text{g}^{-1}$  ( $25^\circ\text{C}$ ,  $1.103 \text{ bar}$ ) of a gas on graphitised carbon black are  $24 \text{ Pa}$  at  $77,5 \text{ K}$  and  $290 \text{ Pa}$  at  $90.1 \text{ K}$ . Calculate the enthalpy of adsorption at this fraction of surface coverage. (3mks)
- b) Distinguish between Lyophobic and Lyophilic solutions. (2mks)
- c) State any three classifications of detergents. (3mks)
- d) Describe the measurement of viscosity using the falling sphere method (3mks)
- e) The sedimentation of bovine serum albumin (BSA) was monitored at  $25^\circ\text{C}$ . The initial radius of the solute surface was  $5.50 \text{ cm}$  and during centrifugation at  $56850$  rotations per minute is recorded as follows:

<b>t/s</b>	0	500	1000	2000	3000	4000	5000
<b>r/cm</b>	5.50	5.55	5.60	5.70	5.80	5.91	6.01

Calculate the sedimentation coefficient. (7mks)

- f) Define sedimentation and state how it can be accelerated (2mks)

**QUESTION FOUR (20MKS)**

- a) What is intrinsic viscosity (2mks)
- b) State and explain any two methods of formation of colloids. (4mks)
- c) Describe electrophoresis (3mks)
- d) Describe the role of soap in cleaning and state the disadvantage of hard water in cleaning using soap (5mks)
- e) State any two methods of producing powders. (2mks)
- f) According to Eley-Rideal mechanism, a gaseous molecule B collides with another molecule A adsorbed on the surface and the rate of product formation is proportional to the partial pressure  $P_B$  of the non-adsorbed gas and to the extent of coverage  $\theta_A$  of the adsorbed gas A. Derive the expression;

$$\text{Rate of product formation} = \frac{kk_P P_A P_B}{1+k_P P_A} \text{ and show that the rate is first}$$

order at high pressure and second order at low pressure. (4mks)

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